

# FORWARD PLANETARY PROTECTION ISSUES AND CONSTRAINTS RELATED TO PLANNING FOR POTENTIAL HUMAN MISSIONS TO MARS



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# Introduction

## **FOUNDATIONAL QUESTION:**

Would the delivery of a crewed mission to the martian surface result in a large biological contamination event for one or more locations on Mars?

***IF YES, WHAT ARE THE IMPLICATIONS?***

# Relationship to Scientific Exploration

*What will change about our thinking about the biological exploration of Mars by the time a human mission reaches the surface?*

## **NOW**

Understanding of habitability improving, no knowledge of habitation

Tight requirements on allowed contamination, planet-wide

2-tiered forward Planetary Protection (PP) approach (Special Regions & other)

## **LOOKING AHEAD**

- A definitive answer for ancient life may be possible with a potential future MSR mission
  - Answers unlikely before ~2030
- For current [extant] life, no life detection missions currently proposed
  - Answers unlikely before ~2030

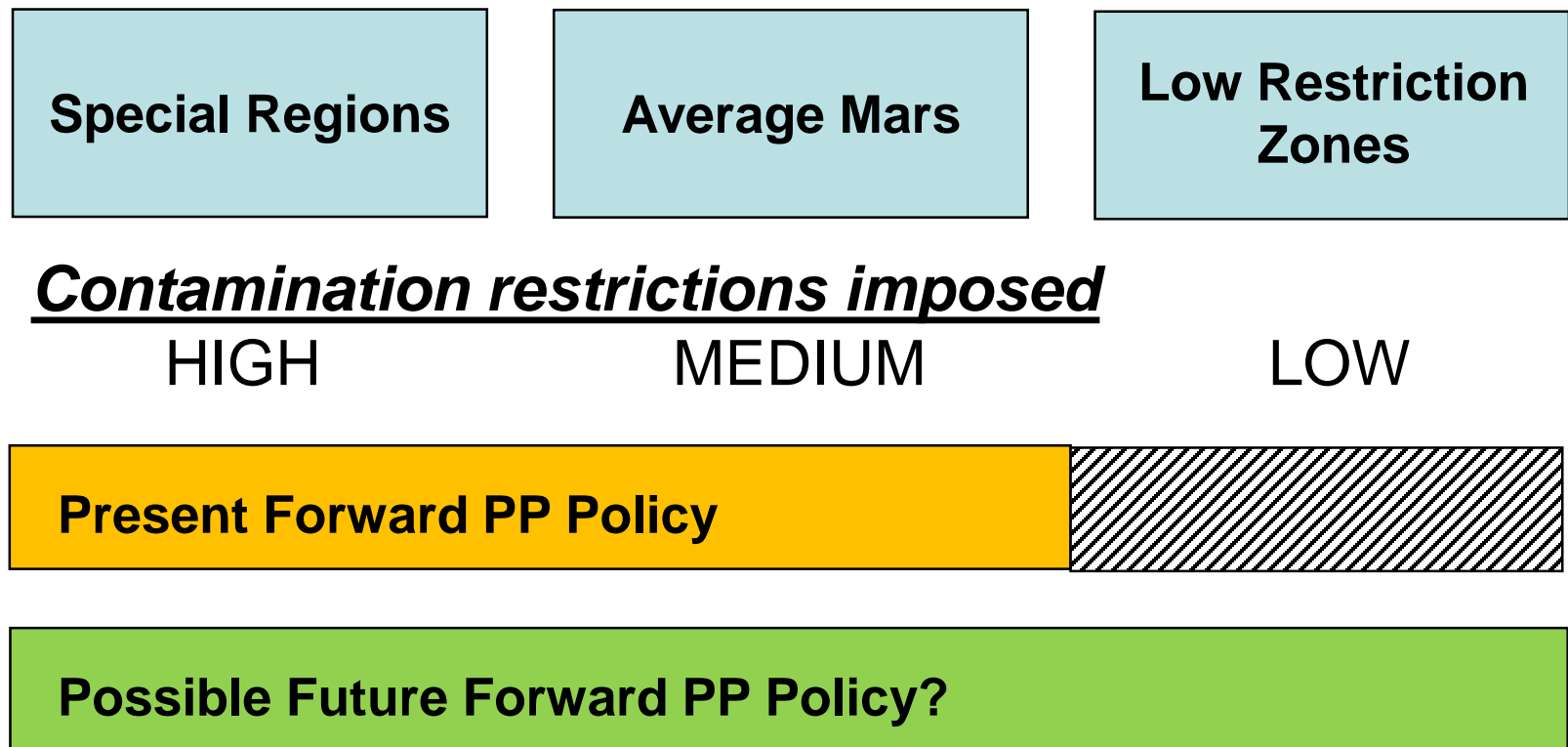
## **KEY LOGIC POINT:**

- Therefore, if the first Mars surface mission happens in the 2030's, there will still be a need to protect areas relevant to the search for extant life on Mars.

***Knowledge Gap #1: We do not have certain knowledge of how the 2030 map that distinguishes definitively special, possibly special, and definitively not special regions will be drawn.***

# Should Future PP Strategy Involve a 3-tiered Forward PP Approach?

Will we need a new PP classification?



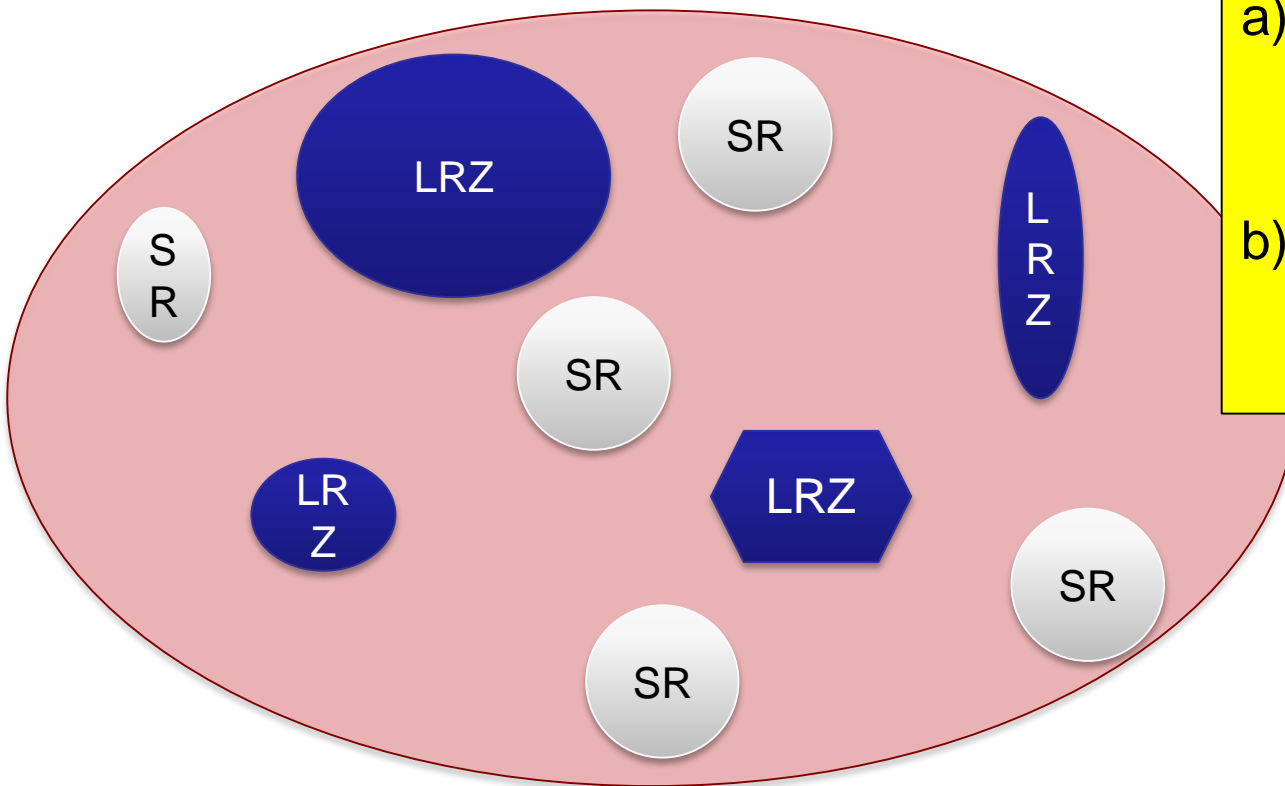
# The Concept of Low-Restriction Zones

IF ANSWER TO QUESTION ON SLIDE #2 IS YES:

Zones of higher allowable contamination **WOULD NEED TO BE IDENTIFIED** in order to permit a human landing.

## KG #2. LRZs

- a) What would be the criteria for identification?
- b) What would be the timeline for this identification?

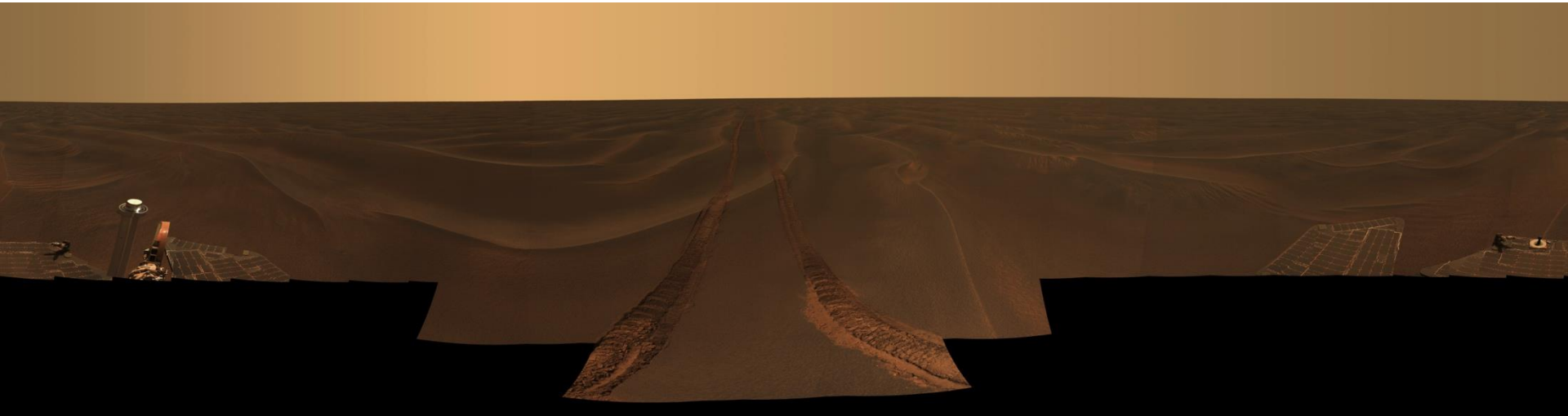


# Low-Restriction Zones: An Existence Proof?

## Example:

Could Meridiani be permitted as a Low-Restriction Zone?

- None of the observations made to date, including both from orbit and from the ground (Opportunity) indicate that it is a modern habitable environment for Earth organisms.



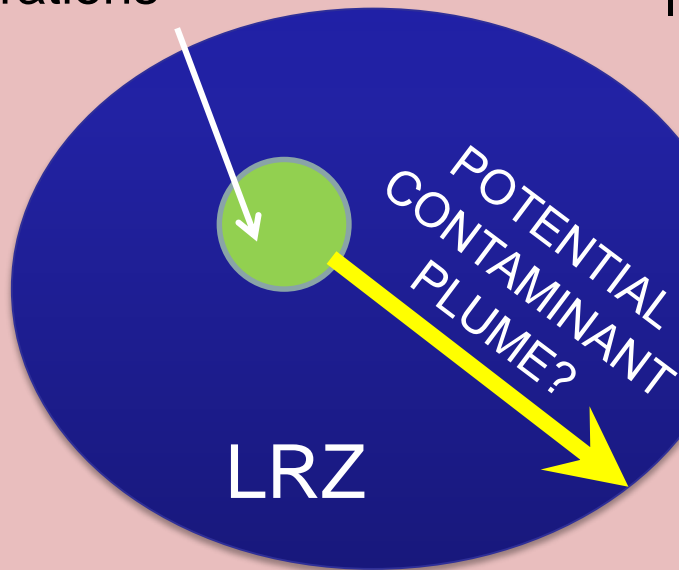
- Would it take a change to the planetary protection policy to allow this?
- How long would it take to change the policy, if required?

# Getting specific: The Issues of Scale and Rate

## Human Exploration

Zone (HEZ): Area of human surface operations

How much contamination could be allowed to reach this limit within TBD time?



***KG#3: How large would an LRZ need to be relative to HEZ?***

***KG#4: Contamination of “average Mars” currently defined in terms of landing events. If contamination arrives by a different process, this definition needs restructuring.***

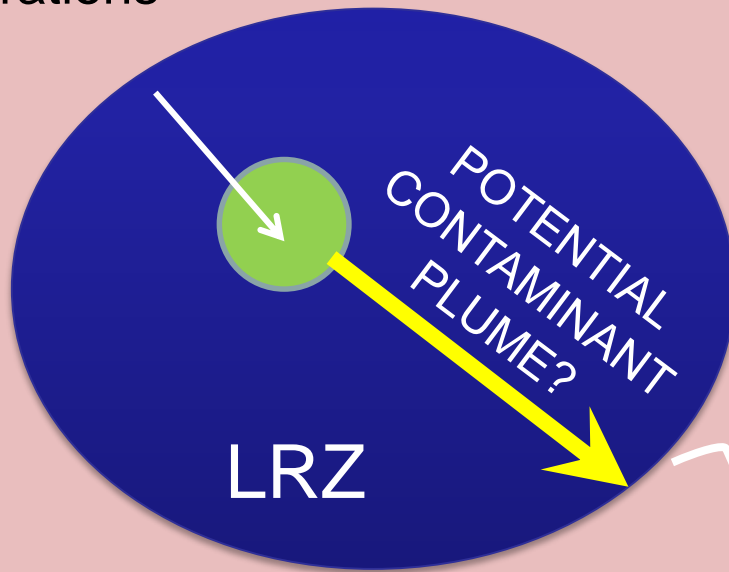
Average Mars: Lower contamination permitted

SR

# Getting specific: The Issues of Scale and Rate

## Human Exploration

Zone (HEZ): Area of human surface operations



Average Mars: Lower contamination permitted

***KG#5: How close could contamination potentially present in an LRZ be allowed to get to Special Regions?***

***KG#6: When might contamination be allowed to get to Special Regions?***

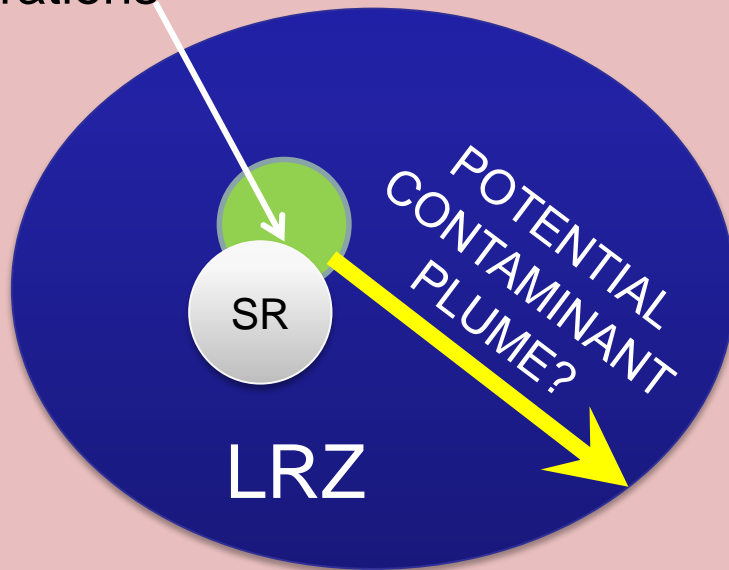
How much separation, and for how long?

SR

# Getting specific: The Issues of Scale and Rate

## Human Exploration

Zone (HEZ): Area of human surface operations

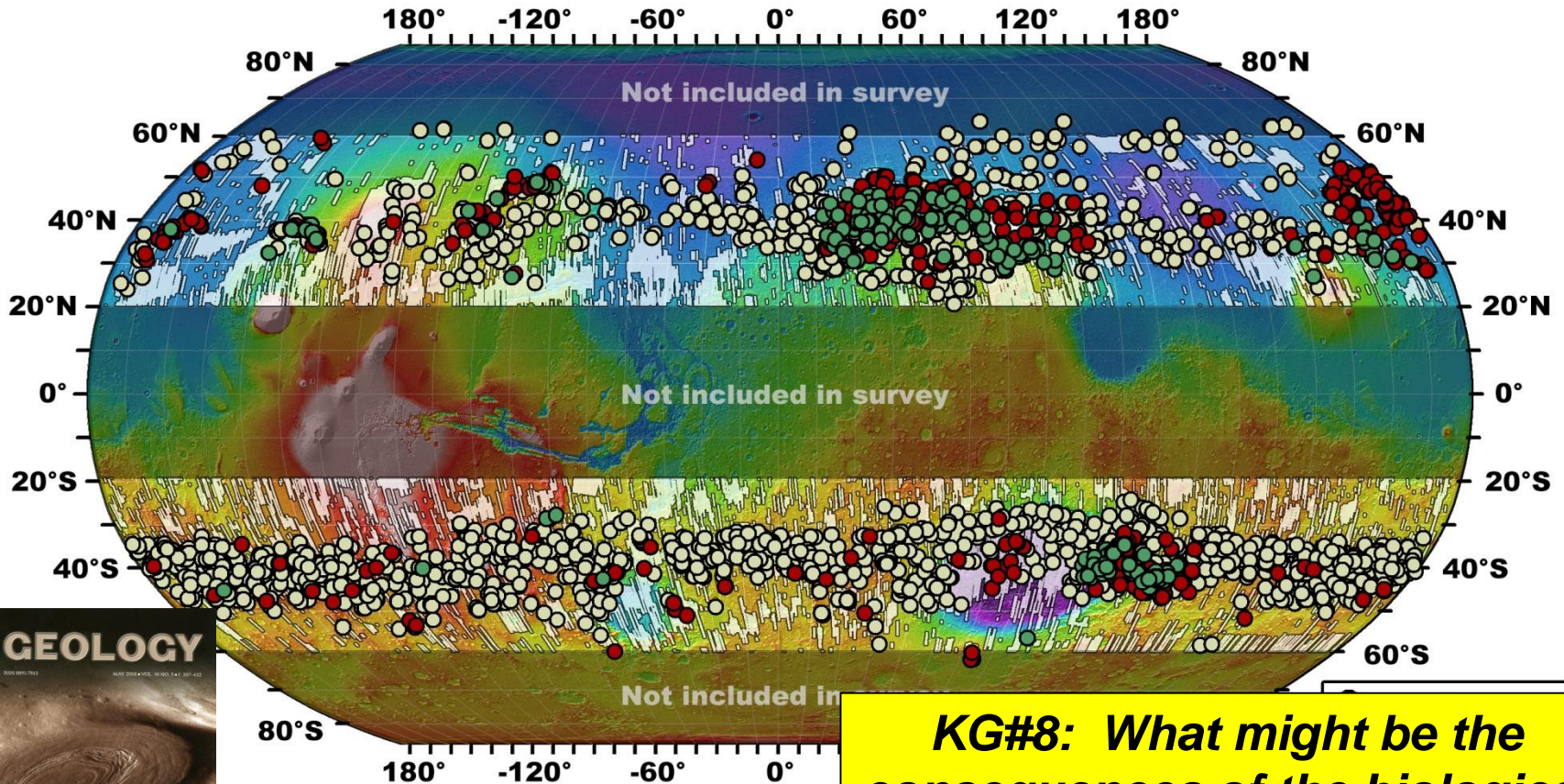


***KG#7: What would be the consequences of sacrificing one or more SRs as part of a Mars surface mission?***

Average Mars: Lower contamination permitted



# Possible Effects on Potential Water Resources



**KG#8: What might be the consequences of the biological contamination of ice deposits?**

*Location of Mid-Latitude Glacial Features*



# Possible Effects on Potential Water Resources

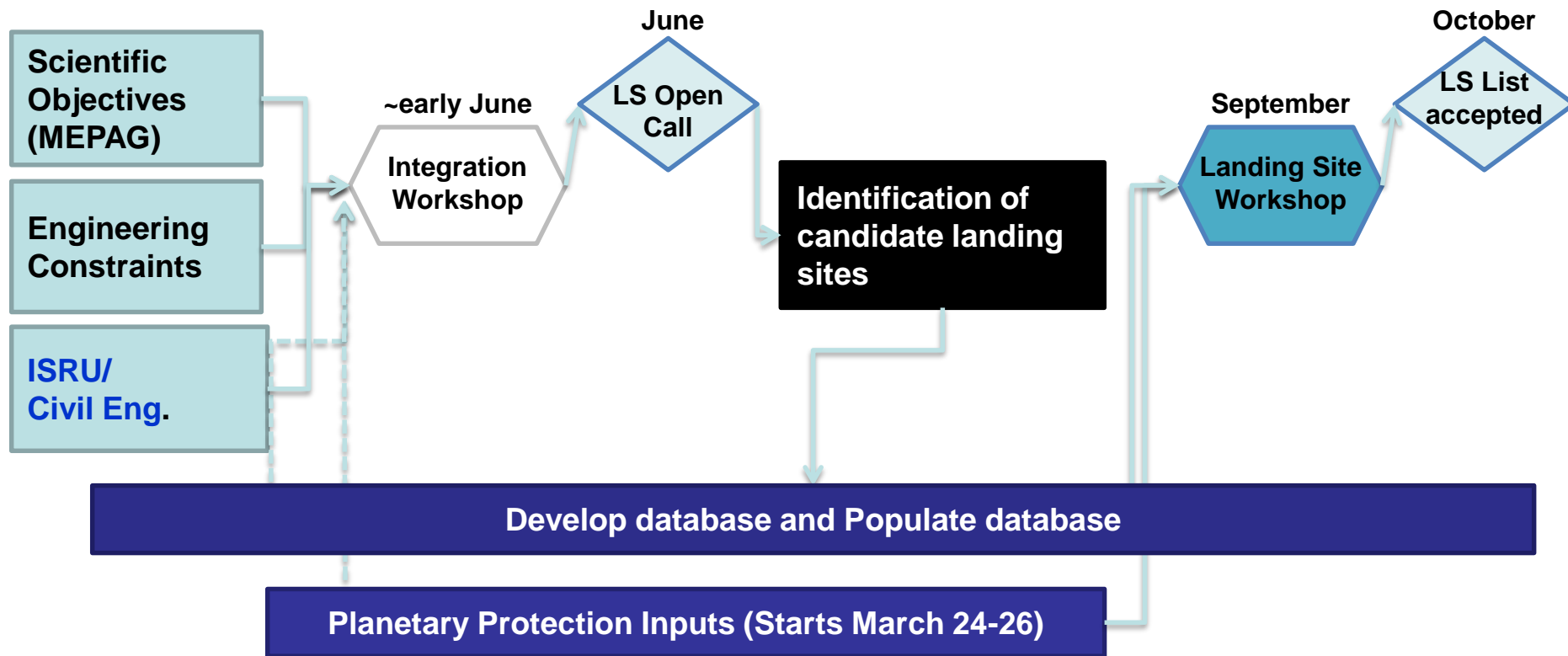
## **Liquid Water:**

- Surface/near-surface brines?
- Possible deep aquifers?

***KG #9: Does Mars have subsurface liquid water? If so, where, and what are its vulnerabilities to biological contamination?***

# A Key Input to Selecting a Human Landing Site

Forward PP is a key issue in landing site selection for a crewed landing.



# What Do We Need to Measure at Mars?

MEPAG maintains a list of the Mars flight investigations and their priorities needed to prepare for a human mission to Mars (Goal IV).

## Special Regions Identification (Currently in Goal IV)

1. Identify where naturally occurring Special Regions are located,
2. Special Regions that could be induced by some element of the human mission)

} IV-2B  
(priority = HIGH)

No meas.  
Called for

## Special Regions contamination avoidance

In the text (but not an investigation): Determine “the rates and scales of the Martian processes that would allow for the potential transport of viable terrestrial organisms to SRs.”

***KG#10: How are we going to know this? What specifically needs to be measured at Mars?***

# Contaminant Transport: Technical Issues

Understanding rates and scales of transport processes of contamination would need to investigate:

- 1) Form and quantities of the biological contaminants
- 2) Factors relating to mechanical dispersal
- 3) What will be the fate of the contamination as a function of time? Would the contamination be irreversible?

Do #2-3 require measurements at Mars? If so, what, and at what level of priority?